10-14-2020

Be Cautious When Interpreting Fall Soil-Test Results Following Drought

Antonio Mallarino
apmallar@iastate.edu

John E. Sawyer
Iowa State University, jsawyer@iastate.edu

Be Cautious When Interpreting Fall Soil-Test Results Following Drought

Abstract

Sampling soil this fall following the dry conditions this past summer, and in some places continuing up to this time, may result in lower than expected soil-test results for phosphorus (P), potassium (K), and pH. Especially if soil samples are collected before any significant rainfall. Therefore, farmers and crop consultants should interpret those soil-test results with caution.

Disciplines

Agricultural Science | Agriculture

IOWA STATE UNIVERSITY
Extension and Outreach

Integrated Crop Management

Be Cautious When Interpreting Fall Soil-Test Results Following Drought

October 14, 2020

Sampling soil this fall following the dry conditions this past summer, and in some places continuing up to this time, may result in lower than expected soil-test results for phosphorus (P), potassium (K), and pH. Especially if soil samples are collected before any significant rainfall. Therefore, farmers and crop consultants should interpret those soil-test results with caution.

P and K removal with crop harvest

Estimates of P and K removal are used to decide fertilizer application to maintain soil-test P and K levels within the Optimum soil-test interpretation category. Prolonged drought can reduce crop grain yield and, consequently, P and K removed with harvest, so the planned removal-based rates may be reduced accordingly. However, a large yield reduction is not likely if below normal rainfall was only from late August, so in these fields the planned removal-based rate should not be reduced. Removal-based rates in fields with low grain harvest recovery from badly lodged corn due to the August or recent windstorms should not be reduced because P and K in unharvested grain will become available for next year crop. Although sampling harvested plant parts for analysis is an option, an easier and effective approach to estimate P and K concentrations per unit of yield is to use information provided in Iowa State University Extension and Outreach publication PM 1688 (A general guide for crop nutrient and limestone recommendations in Iowa). Concentration values in that publication are adjusted from a dry matter basis so they can be directly multiplied by the yield at the standard moisture concentration. For example, values from PM 1688 for corn grain at 15% moisture are 0.32 lb P_2O_5/bu and 0.22 lb K_2O/bu; and for soybean grain at 13% moisture values are 0.72 lb P_2O_5/bu and 1.2 lb

K_2O/bu. It must be remembered that the yield level variation is by far much more important at determining nutrient removal than variation in P or K concentrations.

P and K recycling to soil

Although low rainfall since a crop physiological maturity late in the growing season may not affect yield and the amount P and K removed with harvest, it can greatly reduce the amount of plant P and K recycled to the soil. Normal rainfall leaches plant nutrients into the soil after plants mature (from standing vegetative plant parts) and from crop residue after harvest. Potassium recycling occurs earlier and faster than for P because K in plant tissue is soluble in water and plant P is mostly organic. Research has shown that with good yields and normal rainfall soybean and corn recycle about 80 and 30 lb K_2O/acre of K to the soil, respectively, between physiological maturity and grain harvest whereas additional 30 and 15 lb K_2O/acre are recycled, respectively, from harvest until early December. The recycled K is fully available to the next year crop. For P, the amounts of soluble P recycled are much lower, on average being only 10 and 7 lb P_2O_5/acre for corn or soybean, respectively, for the entire period from physiological maturity until early December.

Therefore, below normal rainfall from the time of physiological plant maturity until the time of soil sampling in the fall will result in much less K recycling to the soil than normal, and consequently lower soil-test K levels than with normal fall rainfall. A small soil-test P reduction is possible but less likely.

Effects on soil sampling and testing

With a prolonged drought, low crop yields, and low P and K removal, post-harvest soil-test P and K levels tend to be higher than expected. However, if below normal rainfall was only from late August, this effect will be small. Conversely, dry soil after crop physiological maturity slows down the normal reactions between soil nutrient pools, which often results in lower soil-test P and K levels. Plants are like pumps taking up P and K from available soil pools, but as nutrient uptake decreases late in the season, normal rainfall and moist soil allow for a replenishment of the available nutrient pools (measured by soil tests) from the less available pools. Dry soil limits soil-test rebound, and often affects soil-test K more than soil-test P. However, the greater impact at reducing soil-test K levels often comes from lack of rainfall reducing K leaching from plants to the soil.

Very dry soil conditions may result in lower soil pH values (more acidic in neutral to acidic soils). Differences ranging from 0.1 to 0.4 pH units lower are common with very dry conditions from late August until soil sampling in the fall. This is because small

concentrations of soluble salts normally present in the soil solution are not leached down to deeper layers by rainfall, which results in higher hydrogen ion concentration and greater acidity (lower pH) in the topsoil. On the other hand, the dry soil effect on buffer pH, which is used to estimate lime requirement, is not large or consistent. Therefore, the main issue with pH measurements with dry soil is taking into consideration that the pH value may under-estimate pH and the decision if lime should be applied or not, but will not affect much the amount of lime to apply.

Another possible problem of sampling during dry soil conditions is that it may increase sampling error because it is more difficult to control the sampling depth and accomplish proper soil core collection. This may be especially serious in no-till and pastures, due to large nutrient stratification with depth; but stratification is also present with chisel-plow/disk tillage. When the top inch of soil is very dry and powdery, it is very easy to lose this soil portion from the core, which will affect the soil-test result significantly.

Suggestions about soil sampling and test results interpretations during drought conditions

1. Consider yield and estimates of P and K removal with harvest during the last two years to decide maintenance fertilization rates for the Optimum soil-test category.
2. Delay soil sampling until meaningful rainfall occurs because it will result in a better sample and more reliable soil-test results, mainly for K and pH. It is not possible to say how much rainfall is helpful, but we believe it should be sufficient to wet the soil throughout the sampling depth (usually six inches) and sampling should be delayed for at least a week after rainfall.
3. If you still have to take the soil samples during dry conditions:
    1. Be careful with sampling depth control and that you collect the complete soil core.
    2. Soil K test results may be lower than they would be with normal conditions due to less recycling to the soil and less replenishment of the soluble or easily exchangeable soil K pools.
    3. Soil P test results probably will be affected little by the recycling issue.
    4. Soil pH test result may be lower than in normal conditions, which may encourage you to apply lime when is not needed yet. However, buffer-pH, which is used to determine the amount of lime to apply, will not be affected much.

For additional information about P, K, and pH/lime management visit the ISU Extension Soil Fertility web site at http://www.agronext.iastate.edu/soilfertility/.

Category: Soil Fertility

Tags: soils fall soil test drought

Authors:

Antonio Mallarino *Professor of Soil Fertility and Nutrient Management, Extension Specialist*

Dr. Antonio Mallarino is a professor of agronomy and nutrient management research and an extension specialist at Iowa State University. His programs focus on agronomic and environmental issues of nutrient management with emphasis on phosphorus, potassium, lime, and micronutrients. Issues addresse...

John Sawyer *Professor*

Dr. John Sawyer is a professor of agronomy and extension specialist in soil fertility and nutrient management at Iowa State University. His extension program involves soil fertility management, efficient crop nutrient utilization, and environmentally sound fertilizer and manure systems. Dr. Sawye...